Original Research Article

Evaluation of foliar nutrition for yield maximization in foxtail millet (*Setaria italica*)

ABSTRACT

A study was carried out on foxtail millet regarding the effect of various foliar treatments in combination with recommended dose of fertilizer on growth, yield and economics of the crop at Tamil Nadu Agricultural University, Coimbatore during summer 2021. Eight treatments in combinations with 100% RDF were arranged in randomized block design with three replications. Foliar treatments applied were *viz.*, RDF + 3% panchagavya (T1), RDF + 3% vermiwash (T2), RDF + 3% TNAU maize maxim (T3), RDF + 1% urea (T4), RDF + 1% KCl (T5), RDF + 0.5% zinc sulphate (T6), RDF + 0.5% iron sulphate (T7) and only RDF (T8). Each treatment was applied at the active vegetative growth stage and panicle initiation stage. From the analysis of the results, it was concluded that application of full dose of RDF along with foliar spray of 3% maize maxim resulted in higher plant height, leaf area index, dry matter production, grain yield and straw yield. Treatments with foliar spray of panchagavya and vermiwash were on par with TNAU maize maxim.

*Keyword**:** Foxtail millet**,** foliar treatment, maize maxim, crop boosters, growth, yield*

1. INTRODUCTION

Global agriculture is highly oriented towards certain industrially valued crops like rice, wheat and maize. This resulted in micronutrient deficiencies in a large part of the population. In this context, cultivation and utilisation of naturally occurring nutrient fortified crops like millets are gaining importance. Small millets contain more nutrients than fine cereals. They are high in carbohydrates, micronutrients and phytochemicals. Millet protein has a better essential amino acid profile than maize protein. Foxtail millet is widely cultivated in Asian and African countries and is considered as the second most important millet of the world (Prashant *et al*, 2022). It is an annual, erect growing millet which is said to have originated in China. It is known to have high fibre (8%) and mineral content like phosphorus, potassium, magnesium and iron. It is also a rich source of protein (12.3) and calcium (13 mg/100 g). It is fairly drought tolerant and can be effectively used as a short term catch crop due to its quick growth.

Foliar nutrition is considered as a quick and easy way of supplying nutrients to the plants. It is highly cost effective and caters to the immediate nutrient requirements at critical growth stages of the crop.

The nutrients get effectively absorbed and translocated to developing plant parts resulting in higher biomass yield. This method can alleviate the problems like fixation of nutrients in soil, limited soil moisture, leaching loss and reduced soil temperature (Latha & Nandanasababady (2003).

Liquid organic manures have the ability to eliminate acute nutrient shortage as it gets easily dispersed in water and is absorbed at 20 times faster pace through leaves. Crop boosters like maize maxim are gaining popularity which is a combination product of essential nutrients and growth regulators which results in improved grain filling and thereby increasing the yield by 20 %. The use of nitrogen fertiliser enhanced biomass yield and protein density in plant tissue. A sufficient supply of potassium can help plants withstand limited moisture and improve physiological efficiency. Zinc regulates the activity of growth hormones and enzyme systems. Iron is acting as an oxygen carrier and helps in chlorophyll formation. Therefore, this study focuses on evaluation of all of these foliar treatments on growth and yield attributes of foxtail millet.

2. MATERIALS AND METHOD

Field experiments were conducted during summer 2020 in Eastern Block Farm under Department of Agronomy at Tamil Nadu Agricultural University, Coimbatore located at Western Agro-climatic zone of Tamil Nadu. The geographical location of the experimental site is 11º0' N latitude and 76 ° 93' E longitudes with an altitude of 427 m above MSL and the mean annual rainfall is 657 mm. The field soil is sandy clay loam with slightly alkaline reaction (pH 7.6) and low soluble salt concentration (EC 1.26 d Sm^{-1}). High organic carbon content (0.69 %) was observed with available nitrogen content being low (270.5 kg/ha). The phosphorus and potassium content was medium (16. 5 kg/ha) and high (713 kg/ha) respectively. In the field, eight treatments were arranged in randomized block design with three replications. Foxtail millet seeds were sown in a spacing of 22.5 cm x 10 cm after application of basal dose of fertilizers (44:22 kg/ha N and P). All other intercultural operations were followed as and when required in accordance with crop production guide (TNAU, 2020). Foliar treatments were given at active vegetative growth stage (25 DAS) and panicle initiation stage (45 DAS) of the crop. Each litre of spray solution required 30 ml of Panchagavya (3%), 30 ml of Vermiwash (3%), 30 g of Maize maxim (30%), 10 g of Urea (1%), 10 g of KCl (1%), 5 g of Zinc sulphate (0.5%) and 5 g of Iron sulphate (0.5%) in order to get the required concentration**.** Various parameters were recorded at 30 DAS, 60 DAS and at harvest stage from tagged plants in each plot in order to assess growth and yield of the crop. Growth parameters like plant height, number of tillers per m^2, leaf area index and dry matter production and yield parameters like productive tillers per m^2, panicle length and panicle weight, number of grains per panicle, 1000 grain weight and grain and straw yield were recorded by following standard procedure. The collected data from each plot was analysed statistically and results were analysed. Wherever the result showed significant, critical difference was worked out at 5% level of significance. Otherwise, it was denoted as non-significant (NS).

3. RESULT AND DISCUSSION

Nutrient management is an integral part of any crop production system. Application of the right quantity of nutrients at the right time has a significant influence on growth and yield of any crop. From

the given study, it can be derived that foliar treatments of nutrients at critical growth stages have resulted in improved growth attributes and higher yield. This can be attributed to the efficient absorption of nutrients from foliar treatment and immediate recovery from the nutrient deficiency. This is in agreement with the findings of Karthika and Maheswari (2017), Rajasekhar *et al.* (2017) and Yassen (2010). The growth parameters like plant height, number of tillers per plant, leaf area index and dry matter production showed a significant variation due to different treatments (Table 1). Among all of the treatments, application of RDF + TNAU maize maxim (3%) showed higher plant height (137.16 cm) and leaf area index (1.37). The treatments with RDF + panchagavya and RDF + Vermiwash recorded a plant height of 134.51 cm and 130.98 cm and leaf area index of 1.35 and 1.26 respectively and was on par with TNAU maize maxim. The maximum number of tillers per plant (2.36) and highest dry matter production (5915.527 kg/ha) was recorded from plots treated with RDF + TNAU maize maxim (3%) which is on par with treatment of RDF + panchagavya (3%). Increased growth parameters by application of crop boosters can be due to the combined effect of macronutrients, micro nutrients and growth regulators present in the right proportion. Similar results were obtained by Sathishkumar *et al*. (2020) by application of TNAU maize maxim which resulted in improvements in growth-related characteristics such as plant height, dry matter production, and the number of tillers m^{-2}, as well as yield-related characteristics such as the number of productive tillers m^{-2}, ear head weight, and nutrient uptake by finger millet in comparison with control.

Table 1: Effect of foliar treatments on growth parameters of foxtail millet

Treatments	Plant height (cm)	No of tillers per plant	LAI	Dry matter production (kg/ha)
T1- RDF +Panchagavya (3%)	134.51	2.26	1.35	5647.84
T2- RDF +Vermiwash (3%)	130.98	2.19	1.26	5327.59
T3- RDF + Maize maxim (3%)	137.16	2.37	1.37	5937.74
T4- RDF +Urea (1%)	121.87	1.96	1.20	5161.24
T5- RDF +KCl (1%)	121.05	1.86	1.152	5064.04
T6- RDF +Zinc sulphate (0.5%)	119.40	1.69	1.16	4670.71
T7- RDF +Iron sulphate (0.5%)	118.98	1.67	1.04	4323.58
T8- RDF alone (control)	115.09	1.61	0.96	3948.87
SEd	6.81	0.11	0.069	339.53
CD (p=0.05)	14.61	0.241	0.148	728.23

Yield improvement is the ultimate aim of any treatments followed. Foliar supplementing of nutrients at reproductive stages of crop helps in effective absorption and translocation to the developing

reproductive parts which results in the improved productivity and quality of the seeds [Fouly *et al*. (2001), Manivannan and Thanunathan (2003), Jayabal (1999)]. The yield contributing factors like productive tillers per plant, panicle length, panicle weight grain yield and straw yield had a commendable response due to various foliar treatments. The number of productive tillers produced per plant (1.94) was more with the treatment of RDF + TNAU maize maxim (3%). Panicle length (23.49 cm) and panicle weight (15.21g) was found to be highest in plants supplied with RDF + TNAU maize maxim (3%). The grain yield (2124.09 kg/ha) and straw yield (4108.14 kg/ha) showed a significant rise due to treatment with RDF + TNAU maize maxim (3%). The productive tiller per plant, grain yield and straw yield recorded from treatments *viz*., RDF + panchagavya (1.85, 2055.45 kg/ha, 3993.05 kg/ha) and RDF+ vermiwash (1.75, 2015.61 kg/ha, 3915.07 kg/ha) was on par with TNAU maize maxim. The balanced nutrient application at appropriate crop growth stage along with necessary growth regulators present in crop boosters resulted in enhanced allocation of nutrients to the reproductive parts and improved grain filling. Devaraju and Senthivel (2018) found that applying crop booster (pulse wonder @ 5 kg/ha spray) in blackgram at flowering and 15 days after spray produced significantly more pods per plant, the highest yield and the highest net return than other foliar spray treatments, which can be attributed to a higher supply of all nutrients during the flowering and pod formation stages of crop growth. This resulted in efficient nutrient translocation from source to sink. These results fall in accordance with the findings of Kunjammal and Sukumar (2019), Kiruthika *et al*. (2018) and Rajeshkumar *et al.* (2017), where they could find improved yield attributes due to the application of crop boosters.

Table 2: Effect of foliar treatments on yield parameters of foxtail millet

Treatments	Productive tiller per plant	Panicle length (cm)	Panicle weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)
T1- RDF +Panchagavya (3%)	1.85	20.98	13.35	2055.45	3993.05
T2- RDF +Vermiwash (3%)	1.758	19.50	12.94	2015.61	3915.07
T3- RDF + Maize maxim (3%)	1.95	23.59	15.29	2130.20	4108.14
T4- RDF +Urea (1%)	1.71	18.67	11.19	1861.33	3772.21
T5- RDF +KCl (1%)	1.72	18.08	10.59	1800.64	3614.84
T6- RDF +Zinc sulphate (0.5%)	1.67	16.31	9.05	1690.74	3588.24
T7- RDF +Iron sulphate (0.5%)	1.63	15.66	8.65	1619.56	3528.36

T8- RDF alone (control)	1.51	13.89	6.60	1523.67	3198.04
SEd	0.11	1.39	0.91	112.20	143.72
CD (p=0.05)	0.24	2.98	1.96	240.65	308.25

4. CONCLUSION

From the study conducted, it is concluded that treatment with 3% TNAU maize maxim at active vegetative growth stage and panicle initiation stage of foxtail millet in addition to the recommended dose of fertilizer resulted in higher growth attributes and yield advantage as compared to control. It was followed by treatments with 3% panchagavya and 3% vermiwash and was statistically on par with maize maxim.

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